Please make the following amendments to the specification as follows:

Please replace the paragraph located on page 3, lines 24-27, with the following amended paragraph:

U.S. Pat. No. 6,444,100 discloses a box shaped hollow cathode sputter source. The bottom of the ~~said~~ box is either electrically floating or connected to the cathode. The box is open to the process chamber and process gas is not introduced into the box other than via the process chamber opening.

Please replace the paragraph located on page 4, lines 8-13, with the following amended paragraph

Applicant's invention includes a plasma source. Applicant's plasma source includes a discharge cavity having a first width, where that discharge cavity includes a top portion, a wall portion and a nozzle disposed on the top portion and extending outwardly therefrom, where the nozzle is formed to include an aperture extending through the top portion and into the discharge cavity, wherein the aperture has a second width, where the second width is less than said first ~~the~~ width.

Please replace the paragraph located on page 4, lines 14-20, with the following amended paragraph:

Applicant's plasma source further includes ~~a power supply,~~ a conduit disposed in said discharge cavity for introducing an ionizable gas into the discharge cavity, and at least one cathode electrode connected to a ~~the~~ power supply, where that cathode electrode is capable of supporting at least one magnetron discharge region within the discharge cavity. Applicant's plasma source further includes a plurality of magnets disposed adjacent the wall portion, where that plurality of magnets create a null magnetic field point within the discharge cavity.

Please replace the paragraph located on page 4, line 22, with the following amended paragraph:

~~FIG. 1 shows~~ FIGS. 1A and 1B show a section view of Applicant's beam source;

Please replace the paragraph located on page 5, lines 17-24, with the following amended paragraph:

~~In certain embodiments, discharge~~ Discharge cavity 26 comprises a parallelepiped having a rectangular cross section. In these embodiments, the first width 110 comprises the width ~~length~~ of the longer side of that rectangular cross section. In certain embodiments, discharge

cavity 26 a parallelepiped having a square cross section. In these embodiments, the first width 110 comprises the width ~~length~~ of one side of that square cross section. In certain embodiments, discharge cavity 26 comprises a cylinder having a circular cross section. In these embodiments, the first width 110 comprises the diameter of that circular cross section.

Please replace the paragraph located on page 5, lines 25-31, with the following amended paragraph:

In certain embodiments, aperture 101 has a rectangular cross section. In these embodiments, second width 115 comprises the width ~~length~~ of the longer side of that rectangular cross section. In certain embodiments, aperture 101 has a square cross section. In these embodiments, second width 115 comprises the width ~~length~~ of one side of that cross section. In certain embodiments aperture 101 has a circular cross section. In these embodiments, second width 115 comprises the diameter of that circular cross section.

Please replace the paragraph located on page 6, lines 20-28, with the following amended paragraph:

Gap 100 separates separate box 3 from block 12 and shunt 11 to eliminate plasma in the gap. In certain embodiments, gap 100 is about 3mm. Gas 27 is introduced into the source

through port 4 in box 3. The gas 27 travels around block 12 via gap 100 between box 3 and block 12. Gas 27 then flows through a plurality of grooves 22 disposed in box 3 and cover 5. Gas 27 is introduced into discharge cavity 26 between cover 5 and liner 16. Cover 5 includes a nozzle 6 ~~though~~ through which the gas 27 flows into the process chamber. The cover 5 and nozzle 6 are water cooled with brazed-on tubing 7. One side of the power supply 17 is connected to cover 5, box 3, and to chamber ground.

Please replace the paragraph beginning on page 8, line 22, and ending on page 9, line 1, with the following amended paragraph:

As those skilled in the art will appreciate, beam source 24 may comprise many shapes, sizes, scales, and may include a plurality of materials. For example, in one embodiment source 24 was constructed as follows: Magnets 1 and 2 were ceramic type measuring about 1" wide x about 4" long x about 1" thick. Magnets 20 and 21 were about 1" wide x about 2" long x about 1" thick. Block 12 was formed from brass. Top cover 5 and nozzle 6 were formed of copper. The opening in nozzle 6 was about 0.75" wide x about 0.75" deep x about 3.5" long. Shunt 10 and shunt 11 were formed of mild steel. Liner 16 was formed of copper sheet bent into an oval shape, with the ~~long internal diameter of that~~ oval measuring about 1.5". As those skilled in the art will appreciate, many variations and modifications can be made regarding the dimensions and

materials of source 24 without departing from the scope of Applicant's invention.

Please replace the paragraph located on page 10, lines 10-13, with the following amended paragraph:

In marked contrast, however, Applicant's beam source 24 can produce ~~the production of~~ a high density, pure oxygen plasma. This has advantages to several processes. In addition, the vacuum pumping requirements are also reduced because argon flow requirements are not a factor when using source 24.

Please replace the paragraph beginning on page 12, line 24, and ending on page 13, line 4, with the following amended paragraph:

FIG. 7 shows beam source 24 disposed above a substrate 23, such as a silicon wafer. In the illustrated embodiment of FIG. 7, the stage 51 supporting the wafer 23 is translated, i.e. moved, in the X and/or Y directions to uniformly treat wafer 23 with plasma 9. ~~In~~ The embodiment in FIG. 7 illustrates ~~illustrated~~ the ability to separately bias substrate 23 and source 24. Bias supply 52, in this case an AC supply of sufficient frequency to pass current through the wafer 23, is connected to stage 51. Beam source supply 17 produces plasma 9. Without the bias supply 52, the insulating substrate 23 would normally rise to the characteristic floating voltage of

plasma 9, i.e. typically between about -10 to about -70 volts for the beam source 24 depending upon process conditions. By turning on bias supply 52, the voltage drop across the plasma dark space between the plasma 9 and substrate 23 can be changed, positively or negatively, to a level required for the process. Because the substrate 23 is not an electrode in beam source 24, it can be separately biased.

Please replace the paragraph beginning on page 13, line 22 and ending on page 14, line 3, with the following amended paragraph:

Cover electrode 5 is electrically isolated from round box 3 insulator plate 76. Cover 5 has a nozzle portion 6 that fits down into the annular opening in electromagnet 70. Liner 16 and cover 5 are connected across power supply 74. The illustrated embodiment of FIG. 11 includes a DC supply with the cathode terminal connected to liner 16. In other embodiments, an AC or RF power supply is used. Box 3 is connect to ground. When power supply 74 is turned on, and gas 27 is flowing into discharge cavity 26, electrons created by magnetron plasma 8 are trapped in mirror field region of magnetic field 18, and plasmas 9 and 30 are created. Thrust is generated as the plasma 9 is expelled through nozzle 6. One component of the thrust is generated by the magnetic nozzle effect. After passing through magnetic mirror 39, electrons then experience a decrease in magnetic field strength as they move outwardly from nozzle 6. In response to this

negative gradient field, electron motion is converted from thermal ~~'hermal~~ spinning to kinetic motion along the axis of the field lines. The electrons in turn electronically pull ions into accelerating away from the source.

Please replace the paragraph located on page 14, lines 4-10, with the following amended paragraph:

~~The electrons in turn electrostatically pull ions into accelerating away from the source.~~ Another form of ion thrust is produced if the magnetic field in region 18 is increased to confine ions, i.e. to a magnetic field strength exceeding at least 1000 Gauss. Under this condition, ions are magnetically confined and heated by the radial electric field as they pass through nozzle 6. As those ions ~~electrons~~ exit the nozzle, they are accelerated by both the electrostatic repulsion from anode 5 and by the magnetic nozzle effect.

Please replace the paragraph located on page 14, lines 11-26, with the following amended paragraph:

The electron confinement achieved using Applicant's source includes physically limiting two of the possible three axial magnetic field electron escape paths by liner 16. The three axial magnetic field regions include: (i) one shaped compressed region 171 ~~18~~, (ii) cone-shaped

compressed region 19, and (iii) planar disk compressed region 170. When liner 16 is connected as the cathode of a DC circuit, or is on a negative AC cycle of an AC power supply, electrons are electrostatically reflected from the liner's surfaces. As electrons attempt to reach the anode electrode 5, they travel by collisional diffusion across field lines 19 and through mirror region 39 to exit the source through nozzle 6 before returning to cover 5. While diffusing across magnetic field lines, the electrons also spiral along these field lines. By configuring the source so magnetic field lines 170 pass through liner 16, electrons moving along these field lines remain electrostatically contained. If field lines 170 were allowed to pass through an electrically floating surface or opposed electrode 5, some number of electrons would escape through the compressed mirror of field lines 170. Allowing only one axial magnetic field region 171 ~~18~~ to be open to electron escape increases the efficient use of electrons in creating and sustaining plasma plume 9.

Please replace the paragraph located on Page 14, lines 27-32, with the following amended paragraph:

FIG. 10 shows beam source 100. In various embodiments, source 100 is circular, annular, or extended length wise. In the illustrated embodiment of FIG. 10, source 100 includes rare earth magnets 1 and 2, and two power supplies 83 and 84. Power supply 83 is connected

between ~~connects~~ cathode liner 16 and ~~to~~ box 3. Insulator 81 separates ~~separate~~ box 3 electrically from cover 5. Power supply 84 is connected between ~~connects~~ anode cover 5 and ~~to~~ box 3. Box 3 ~~three~~ is grounded.

Please replace the two paragraphs located on page 15, lines 1- 21, with the following amended paragraph;

Using the illustrated configuration of FIG. 10, the plasma 9 potential can be adjusted relative to ground. This is useful when applying the plasma 9 to a grounded substrate. By increasing the plasma 9 potential, the ion energy striking the substrate is increased. FIG. 10 further illustrates process gas manifolds 80 built into cover 5. Small distribution holes 85 conduct the gas 27 uniformly along the length of source 100 into discharge cavity 26. Facing the magnets 1 and 2 toward each other in a cusp arrangement, creates a strong mirror compression ratio in mirror region 39. With rare earth magnets 1 and 2, the field strength at the mirror apex can exceed 500 Gauss. As electrons pass through this mirror region 39, they experience this strong field and their Larmor gyro radius is correspondingly small. Under these conditions, when the plasma is viewed from the end as in this section view, the plasma 9 width passing through nozzle 6 is very narrow, on the order of 3 mm. This strong cusp field is an advantage over vertically directed magnets of Window and Savvides, Helmer, and others. ~~A vertical~~

~~magnet orientation is shown in another preferred embodiment in FIG. 11.~~ With vertically oriented magnets, while a null region 25 is created above the magnetron confined region 8, the field strength is typically less than 100 Gauss and the electron Larmor gyro radius is larger. In the illustrated embodiment of FIG. 10, shunt 10 is fitted into aluminum body 12. Shunt 10 reduces the sputter rate of liner 16, and evens out liner 16 sputtering to make the liner 16 last longer. While helpful in this regard, shunt 10 is not necessary to the fundamental source operation.

Please replace the paragraph located on page 15, lines22-26, with the following amended paragraph:

~~Body~~ <u>In source 100 body</u> 12 is water cooled by extruded holes 82. Insulators 14 and 86 support cathode body 12 in box 3 and electrically isolate the cathode, i.e. body 12 and liner 16, from box 3. Source 100 may be rectangular having an extended length. End magnets, used to make both magnetic field regions 8 and 9 closed paths, are not shown in FIG. 10.

Please replace the paragraph beginning on page 15, line 27, and ending on page 16, line 1, with the following amended paragraph:

FIG. 11 shows beam source 1100 having vertically oriented magnets. This magnet

configuration is representative of a Type II unbalanced magnetron magnetic field as taught by Window and Harding. A range of magnet 97 shapes, and discharge cavity 103 ~~26~~ shapes, can be implemented within the scope of Applicant's invention. In the illustrated embodiment of FIG. 11, magnets 97 create two confinement regions: magnetron confinement 101 ~~95~~ at cathode 98 surface 105, and mirror/nozzle confinement 93 through nozzle 104.